Na LMR R&D Planning

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Generation IV

Joint TWG/CCG Meeting

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Overview of the Presentation

- Quick status of TWG 3 R&D Scope Report
- Specific concept notions
- Principles that drive the R&D planning
- Pyroprocess R&D
- Advanced Aqueous Process R&D
- Reactor R&D



TWG 3 R&D Scope Report

- Scope is L1/L2 and L6/L4
- ~235 pages that includes descriptive material, concept rationale, synergies, R&D plans, summary R&D tables, PRIMAVERA schedules (for fuel cycle only)
- Intent was an encyclopedia from which RIT needs could be satisfied



TWG 3 R&D Summary Tables

- ~25 pages in 5/31 and 6/24 drafts
- Obviously need prioritization, rollup, integration
- Little peer review thus far: a main subject of TWG 3 business tomorrow
- Cost estimates largely missing



Na LMR Concepts That Drive R&D Choices

- Metal-alloy fueled reactor, range of sizes from medium to large, pyroprocess fuel cycle (L2)
- Oxide fueled reactor, same range of sizes, advanced aqueous-based process (L1)
- Other dry processes also recognized, but little emphasized



Principles that Guide the R&D Planning

- Fuel Cycle R&D deserves heavy emphasis
- Fuel cycle technology development must consider LWR spent fuel
- Na LMR reactor technology is anything but static or a done-deal. Reactor-related R&D is <u>needed</u>, in some cases to capture innovations that can lead to significant cost reduction:
 - fuels and materials
 - passive and/or inherent safety assurance
 - inservice inspection and repair
 - components etc.



Pyroprocess Viability R&D

- Application of pyroprocess applicability to LWR spent fuels
 - Demonstrate pyrochemical reduction of oxide fuel
- Demonstration of actinide recovery, recycle
 - TRU recovery demonstration
 - Develop drawdown system for actinide removal from salt
- Minimization of HLW
 - Development of ion exchange system to reduce ceramic waste volume
- Develop integrated safeguards



Advanced Aqueous Process (and Simplified Remote Pellet Fabrication) R&D

- Separations Process Development
 - Development of powdering decladding system
 - Verification of uranium crystallization performance
- Simplified Pellet Fabrication
 - Development of denitration/conversion turntable system
 - Confirmation of fabricability (e.g. sinterability) of MA-bearing MOX
 - Verification of weld inspection methods for ODS cladding
 - Demonstrate remote operability/maintainability of fab equipment
 - Development of alternative gelation fab method
- Waste Management
 - Minimization of TRU waste (salt-free reagent; improved decon technology)

Alternative Dry Process (and Vibropac Fuel Fabrication) Viability R&D

- Verification of MOX co-deposition in electrowinning
- Verification of vibropac process
- Assurance of vibropac equipment operability/maintainability



Fuels Viability R&D

- Irradiation performance of remotely-fabricated fuel containing prototypic minor actinides (metal or oxide)
- Key thermophysical property confirmation for MA-bearing metal fuel
- Modeling and basic data for fuel/cladding interdiffusion and fuel constituent migration for MA-bearing metal fuels



Safety Viability R&D

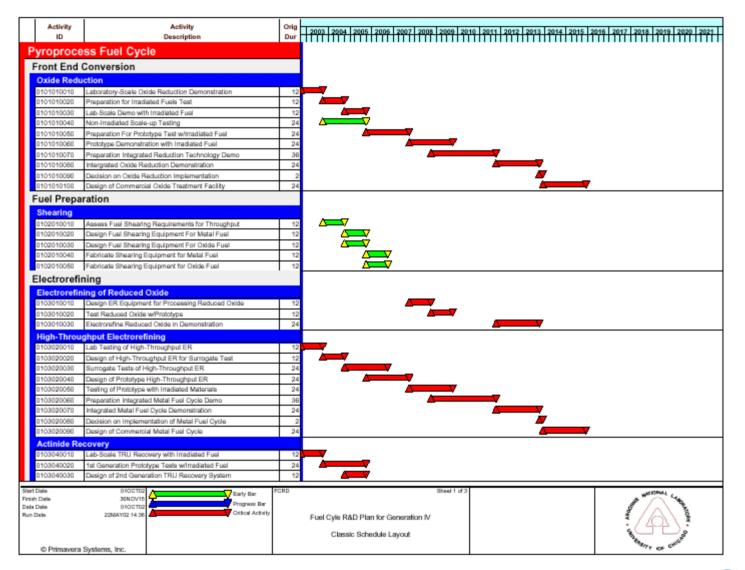
- Complete the data base for axial expansion of metal fuel in overpower transients
- Verification of the key reactivity feedbacks in undercooling accidents, radial expansion and assembly bowing
- Development of Curie-point magnet alloys for use in SASS systems



How TWG 3 Handled R&D Scheduling

- In the Scope Report of 6/24, we developed PRIMAVERA schedules only for fuel cycle R&D
- Tentative plan is to expand to all the Na LMR and Pb-Bi Battery R&D
- Closing slides show how this looks for the Pyroprocess R&D







Activity	Activity Description	Orig	
0103040040	Lab Testing 2nd Generation TRU Recovery	24	
	Design of 2nd Generation TRU Recovery Prototype	12	<u></u>
0103040060	2nd Generation Prototype Test w/mediated Fuel	18	<u> </u>
Actinide Dra			
	Conceptual Testing of Drawdown Equipment	24	/
	Design of Drawdown Equipment for Irradiated Test	12	
	Testing Drawdown Equipment with Irradiated Fuel	12	
Fuel Fabric	•		-
Salt Remova	al from Cathodes		
	Optimization of Distillation for Salt Removal	24	
0104010020	Design of Improved Salt Separation System	24	
0104010030	Testing Improved Salt Separation System	24	
Fuel Castino			
0104020010	Optimization of Fuel Casting Technology	24	
0104020040	Develop Improved Fuel Mold Technology	24	
0104020040	Design of Fuel Casting Equipment for Prototype	24	
0104020020	Demonstration of Fuel Casting Technology	24	
0104020050	Test improved Fuel Mold Technology	24	
Crucible Ma			
	Test Crucible Materials for Casting	24	A
0104030010	-	30	
	Test Crucible for Salt Separation	12	
	Finalize Cruobles for Casting	_	
	Finalize Crucibles for Salt Separation	12	
Fuel Fabrica			
0104040010	Review of Remote Fuel Fabrication Systems	24	
0104040020	Design of Remote Fabrication for Testing	24	
0104040030	Testing of Remote Fabrication Systems	18	
Netal HLW			
Waste Quali	fication		
0105010010	Finalize QA System for Waste Form Work	12	.
0105010070	Assessment of Oxide Metal Waste Form Options	12	
0105010020	Develop Metal Waste Qualification Test Plan	12	
0105010080	Testing of Oxide Metal Waste Form Options	12	
0105010110	Prepare Waste Acceptance Product Specification	12	
0105010090	Decision on Metal Waste for Options for Oxide	€	<u> </u>
0105010120	Prepare Waste Compliance Plan	12	<u> </u>
0105010030	Complete Metal Waste Qualification Testing	24	<u> </u>
0105010130	Prepare Waste Qualification Report	12	
0105010100	Oxide Metal Waste Testing for Qualification	24	<u> </u>
0105010040	Review of Waste Qualification Data	12	
Date	010CTD2 Carty Bar	FORD	Sheet 2 of 3
Date Date	20NOV15		<i>₱</i>
	22MAY02 14:36 Catholic Activity		5-10-5-010-5
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Activity ID	Activity Description	Orig Dur	2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 20
0105010050	Repository Impact Assessment of Waste Data	12	
0105010060	Acceptance Review of Waste Data	12	<u> </u>
Production	Process Qualification		
0105020010	Review of Metal Waste Production Process	12	<u> </u>
0105020020	Complete Design of Demo Metal Waste Equipment	24	<u> </u>
0105020030	Metal Waste Process Qualification Testing	36	<u> </u>
Ceramic H	LW		
Waste Qual	lification		
0106010010	Develop Ceramic Waste Qualification Test Plan	12	/
0106010020	Complete Ceramic Waste Qualification Testing	24	
Process Qu		2.4	
	Complete Design Demo Ceramic Waste Equipment	20	A
0106020010		36	
	Perform Ceramic Waste Qualification Testing	36	
	ge Process		,
0106030010	Assess Waste Volumes for Throw Away Flowsheet	12	
0106030015	Decision on Use of Ion Exchange Process	1	<u>ar</u>
0106030020	Perfrom Lab-Scale Ion Exchange Tests	12	
0106030030	Design IX Equipment Demo-Scale Test w/Surrogates	18	4
0106030040	Test Demo-scale IX Equipment w/Surrogates	12	^
0106030050	Design Demo-Scale IX Equipment Irradiated Test	18	
0106030055	Test IX Equipment will radiated Materials	12	Δ=
Process C	ontrol and Accountability		
Process Mo	odeling		
0107010010	Assess Status of Present Process Models	24	<u> </u>
0107010020	Complete Development of Batch Process Models	36	<u> </u>
0107010030	Validate Proess Models	1.8	<u> </u>
Accountable	ility Development		
0107020010	Assess Established Accountability Systems	24	
0107020020	Implement Improvements to Accoutability System	36	
0107020030	Assess Improvments to Accountability System	18	<u> </u>
Internation	al Fuel Cycle Transparency		
0107030010	Perform International Assessment Pyro Fuel Dyole	36	
0107030020	Demonstration Fuel Cycle Transparency	18	 ∆
	tive Analysis		
0107040010	Develop NDA Techniques for Fuel	36	7
0107040010	Develop NDA Techniques for Process Streams	36	
0107040030	Demonstrate NDA Techniques	1.0	
0107040030	Demonstrate NDA Techniques	16	
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